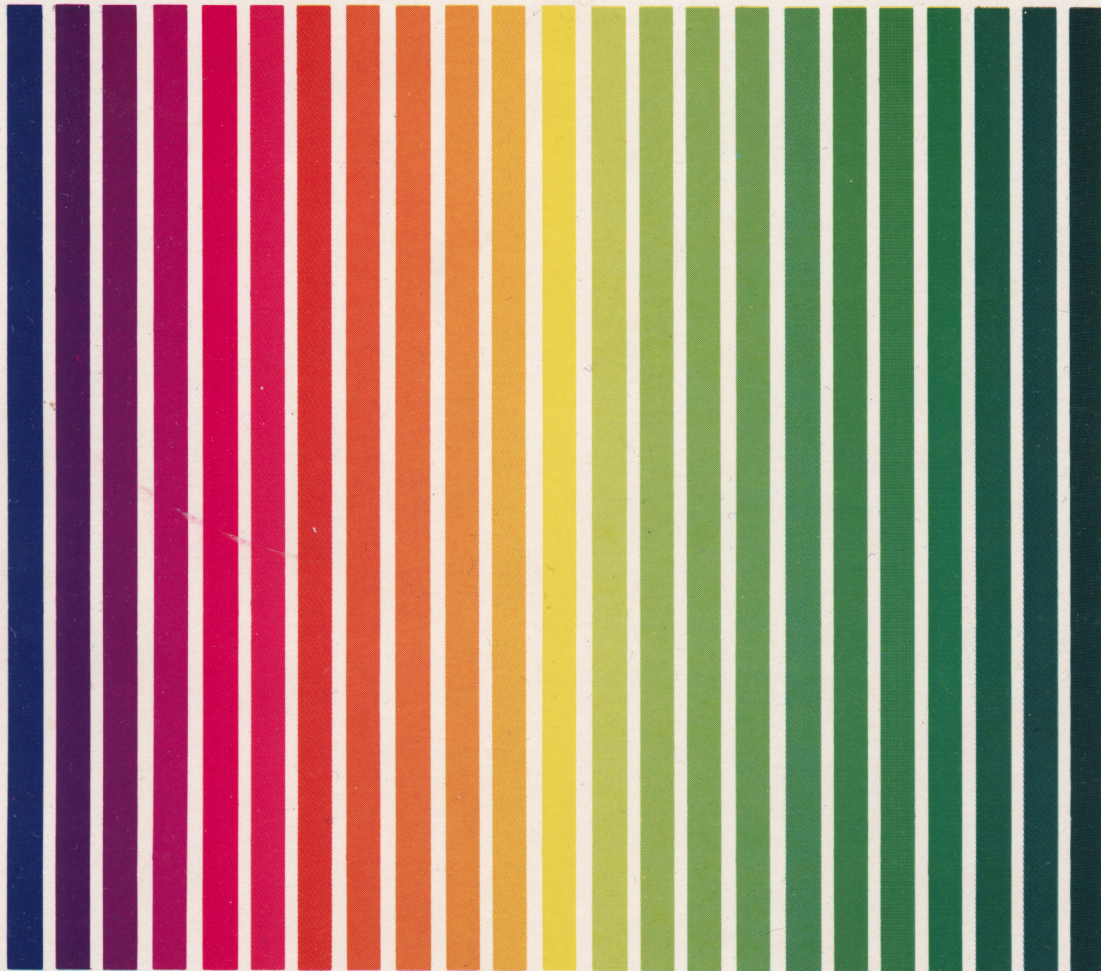


# APX ATARI® PROGRAM EXCHANGE



Michael Crick

## **FROGMMASTER**

A fast-moving game for 1-4 players based on  
behavior modification (ages 9 and up)

Diskette: 24K (APX-20131)

User-Written Software for ATARI Home Computers



Michael Crick

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A fast-moving game for 1-4 players based on  
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# FROGMASTER

by

Michael Crick

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## INTRODUCTION

### OVERVIEW

Here's a totally new concept in computer games. Inside each frog or tadpole on the screen is a primitive brain -- entirely simulated by the computer. This enables the critters to learn, or rather be trained, just like real animals. On the surface, FROGMASTER is a fast-moving, high-concentration, competitive game for one to four players. Underneath, however, it's a fascinating exercise in learning how to use operant conditioning to train animals.

The setting is a "football pond" and the object is to train tadpoles to cross your opponent's goal line. Meanwhile your opponent is training tadpoles to invade your goal line; the first side to score 50 points wins. Left to themselves, the tadpoles dart about randomly, but when you reward them, by pressing the red Joystick Controller button, they learn to swim in the right direction. When rewarded, the tadpoles glow with pleasure, squeak with delight, and jump again in the same direction. Rewarding also modifies the dozen primitive brain cells that control each tadpole's behavior. Your aim is to condition these brain cells to turn inept tadpoles into dedicated scorers. Your tadpoles should also be trained to avoid hungry linebackers and a rapacious goalie -- or they will get eaten alive. You can get more challenge by adding walls (which must be penetrated) and metamorphosis -- where tadpoles change into jumping frogs that lay eggs and eat opposing players!

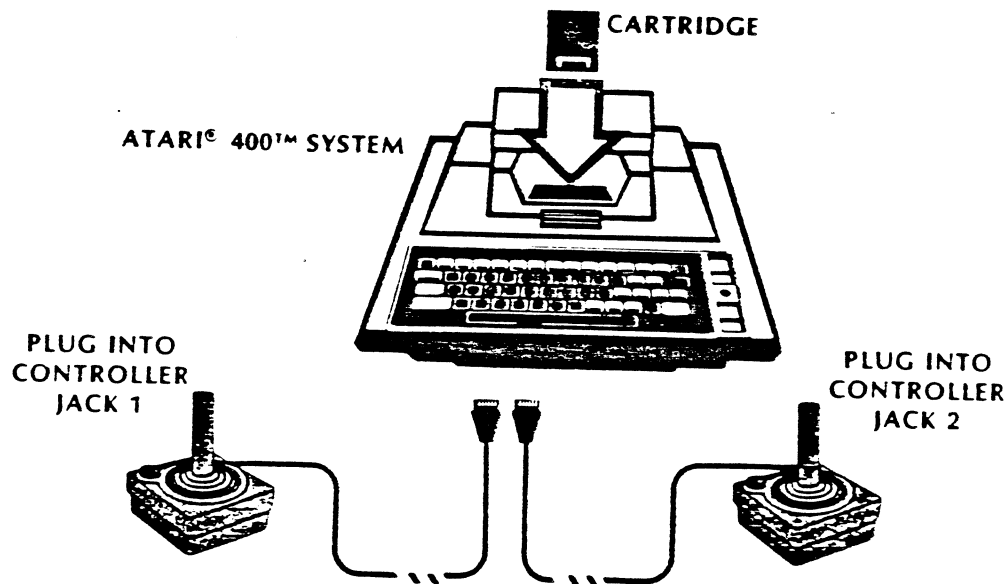
### REQUIRED ACCESSORIES

24K RAM  
ATARI BASIC Language Cartridge  
ATARI 810 disk Drive  
One Joystick Controller per player

## GETTING STARTED

### LOADING FROGMASER INTO COMPUTER MEMORY

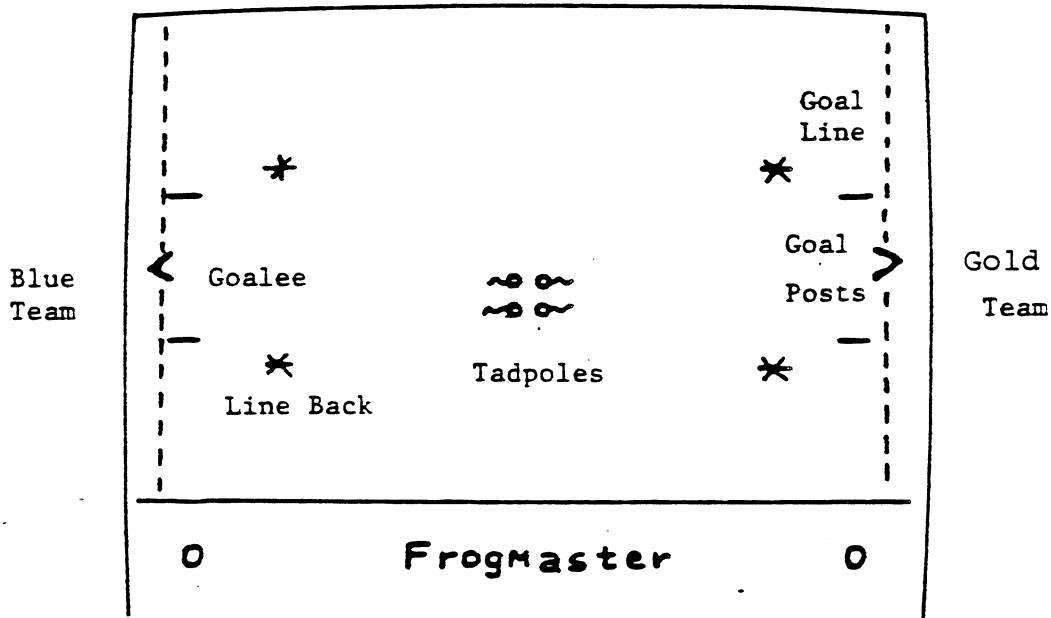
Before you start, make sure that you have the ATARI BASIC Language Cartridge in the cartridge slot of your computer. Turn on your television set. Plug in one or more Joystick Controllers in the controller jacks as shown below!



Turn on disk drive #1. When the BUSY light goes out, open the door and insert the FROGMASER diskette with the label in the lower right-hand corner nearest to you. Turn on your ATARI Home Computer. FROGMASER loads automatically into computer memory.

### THE FIRST DISPLAY SCREEN

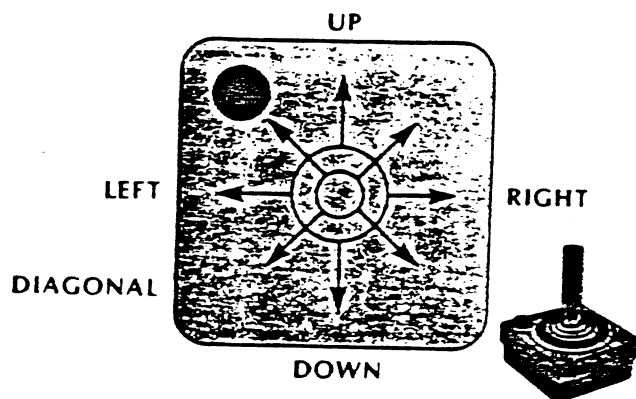
When the game starts you will see the football pond laid out as illustrated below:



The whistle blows. The four tadpoles in the middle of the screen start darting around on their own. On each side there is a goalie and two line backs. The line backs stay where they are and attack any tadpole that comes too close. The goalies move up and down the goal line. You control your goalie with your Joystick Controller.

### MOVING THE GOALEES

Hold your Joystick Controller so that the red button is at the top left as shown below:



Move the Joystick in the direction marked UP and one of the goalies will start to move upwards. If the blue goalie on the left moves, then you are in charge of the Blue Team whereas, if the gold goalie on the right moves, you're in charge of the Gold Team. The goalies only move up and down. Moving the Joystick sideways has no effect. Thus, it is important to hold the Joystick Controller the right way.

The purpose of the goalies is to intercept incoming tadpoles as they try to score by reaching the goal line. The goalies are quite effective against a straight forward attack by a single incoming tadpole, but they are usually foiled by a multiple attack or by tadpoles that have been trained to weave.



## PLAYING FROGMASTER

### INTRODUCTION

Your mission is to get your tadpoles across the opponent's goal line.

Left to themselves, the players just dart around at random, like so many dumb tadpoles --- but, if you reward them just right they will learn to swim in the right direction. It is a matter of timing. You reward them by pressing the red Joystick Controller button just after the move. Then they glow with pleasure, squeak with delight, and make another jump in the same direction. More than that, they try to figure out what it was that they were doing right when you rewarded them and then they tend to do that particular thing more often. Each critter has a dozen primitive brain cells that control its behavior. Reward them just right and you can train any critter to be a star player.

You win by scoring 50 points.

Tadpoles score ten points between the goal posts and five points outside. However, before they're trained, they just doodle around in centerfield. Your first job is to get them trained. When enemy tadpoles attack your goal line you can rebuff them with your goalie (controlled with your Joystick Controller). The goalies may be evaded by using a zig-zag approach or by invading the goal line in two places at once. There is no perfect defense and the only way to win is to train your tadpoles to attack.

Then, when you have mastered playing with just tadpoles, you can add walls and metamorphosis -- where tadpoles turn into frogs that lay eggs and eat members of the opposing team!

### BASIC TRAINING

Before you can train your tadpole to score for you, you will need a little training yourself. Training isn't hard, but there is a knack to it. A moment of dedicated practice and it is easily mastered.

Before challenging an opponent, first hone your skills. After getting FROGMASTER started:

- 1) Press the OPTION key three times to change the speed to SLOWEST,
- 2) Press the "1" key to reduce the number of tadpoles to one on each team, and
- 3) Press the START key

These steps make the training process easier to follow.

Now use the Joystick Controller plugged into controller jack #1. This is the controller for the blue team. Carefully watch the blue tadpole. If it darts to the right, toward the opponent's goal line, immediately press the red Joystick "reward" button. If you have your timing right the blue tadpole will

- 1) momentarily glow with pleasure,
- 2) make a squeak of delight, and
- 3) make an extra jump toward your opponent's goal line

If your timing is off, either nothing will happen or the other tadpole will respond, which is not what you want.

You will now observe that after you have rewarded your critter a few times, it starts to move fairly consistently to the right. Soon it will reach the opposition's goal line and score for you. If you now stop training it, it will keep moving generally to the right and score several more goals. The critters gradually forget what they have been taught and resume moving more or less at random.

To verify that you understand the training process, watch the tadpole that you trained to move to the right, and reward it only when it moves to the left. If you have it well trained, you may have to wait a while before it makes a jump to the left. However, after the first reward, the training goes much faster. As you train it, you will notice that it suddenly changes from blue to gold. Tadpoles trained to move right are colored blue and those trained to move left are colored gold. The tadpoles have no intrinsic loyalty and may be trained to play for either side. All the tadpoles are potential players for your team no matter which side they happen to start on.

Note that although Joysticks one and two move different goalees, all the red Joystick "reward" buttons act the same and any reward button can reward any tadpole. The effect of pressing any reward button depends entirely on your timing.

When you and your opponent have completed basic training, you can start your first duel. Press the SYSTEM RESET button and type RUN and the game will restart with two players on each side.

Scoring is easy. Each tadpole scores five points plus five bonus points for scoring between the goal posts. The first team to score 50 points is the winner.

## GAME OPTIONS

Variations on the basic game may be obtained using the following keys:

OPTION	Displays and selects the speed (see "Changing Speed").
SELECT	Displays the game mode (e.g. PLAYER vs PLAYER) and lets you select other game modes (see "Playing the Computer").
START	Restarts the game. Scores are reset and all training is lost.
"P"	Causes the game to pause.
RETURN	Restarts play after a pause.
"0" - "9"	These keys normally reset the number of critters per team. The effect is latent and you may also have to press START. The number keys have a different meaning when DISPLAY is on.
"W"	Turns WALLS on and off. You must also press START (see "Adding Walls").
"D"	Turns DISPLAY on and off (see Notes on Learning Theory).
"M"	Displays METAMORPHOSIS and lets you turn it on and off. The effect is immediate. When METAMORPHOSIS is on, tadpoles turn into frogs and frogs lay eggs, and so on (see "Metamorphosis").
"G"	Lets you turn the game features off and on (see "An Experimenter's Environment")

METAMORPHOSIS and DISPLAY are covered in more detail in the sections entitled "Metamorphosis" and "Notes on Learning Theory". The rest of this section elaborates on some of the other options.



## SCORING

You need 50 points to win. In the standard game, tadpoles score five points for reaching the goal line, plus five bonus points for scoring between the goalposts.

In the advanced game, with METAMORPHOSIS set on, the scoring mimics football. Tadpoles always score three points. Frogs score six points plus an extra point for "conversion" if they score between the goalposts.

## CHANGING SPEED [OPTION BUTTON]

There are three speeds -- FULL SPEED, SLOW, and SLOWEST. The default setting is SLOW. SLOWEST is recommended for beginners and FULL SPEED is for experts who find the SLOW setting too sluggish.

When you press the OPTION key once, the current speed is displayed in the middle of the bottom panel. Additional presses cycle the speed through the three options. The game will resume automatically after a small delay. If you're in a hurry, press RETURN and play will resume at once.

## PLAYING THE COMPUTER [SELECT BUTTON]

Pressing the SELECT key once causes the current type of competition to display on the bottom panel. Additional presses cycle you through the following choices:

player vs player  
player vs player (handicap)  
computer (handicap) vs player  
computer vs player  
player vs computer  
player vs computer (handicap)  
player (handicap) vs player

The game will resume automatically after a delay. You may resume play at once by pressing the RETURN key.

The effect of a handicap is to add a sort of tilt to the game so that the critters will tend to move toward the handicapped player's goal line. The handicapped player has to train his players harder to produce a given effect.

When playing the computer, a similar tilt is introduced, biasing the game against the human player. When either you or the computer has a handicap, the bias is moderate. When neither you nor the computer has a handicap, victory over the computer requires considerable concentration. When you play the computer, you will notice its goalkeeper moving into position automatically as you approach. Just like human opponents, the computer may be foiled by weaving and by attacking on both ends of the goal line at once.

FROGMASTER was not designed as a one-person game and you'll find it most exciting when you match wits with a real human opponent.

#### CHANGING THE NUMBER OF CRITTERS [0 - 9]

You may change the number of critters on each team by pressing a number key, "0" through "9", and then pressing START.

If you press 0 - there will be a total of exactly one critter. All other numbers produce the appropriate number of pairs of critters.

When DISPLAY is on, these keys have a different meaning. You must turn DISPLAY off by pressing the "D" key before resetting the number of critters.

When you have METAMORPHOSIS on, it isn't necessary to restart the game. Since, in this form, critters are always dying and laying eggs. The effect of resetting the nominal number of critters is an adjustment of the birth and death rates to keep the actual number in the general range that you specified. For example, if you start with two critters per team and press the "5" key, the number of critters will gradually increase to an average of about ten.

#### ADDING WALLS ["W" KEY]

To add to the challenge of the game, you may create a pair of walls lying between the line backs and the goalie on each side. If you press the "W" key once, the bottom panel will tell you if the WALLS function is on or off. Pressing the "W" key a second time changes the WALLS setting. You must then press START to restart the game with the selected setting.

When a tadpole rams into a wall, it may either rupture the wall or just bounce off it. This behavior, like almost everything in FROGMASTER, may be influenced by training. Clearly, you want to reward your own tadpoles for annihilating walls while rewarding your opponent's tadpoles when they bounce off.

Frogs also bounce off walls, but they can leap over them if they jump high enough (another property subject to training). If you reward your opponent's frog for bouncing off your wall, you will make it harder for that frog to get over in the future and you will give it a boost toward your opponent's goal line.

#### PLAYING DOUBLES

To play FROGMASTER with four players, plug two additional Joystick Controllers into controller jacks three and four. The Joysticks on these controllers have no effect and you must use the Joysticks in the first two jacks to control the goalies (as before). The reward buttons on Joysticks three and four behave exactly like those on Joysticks one and two.

Normally, one player on each team will play defense and operate the goalie, while the other player concentrates on rewarding. However, there is nothing to prevent the defender from rewarding and helping out on the attack side. A critter may be rewarded twice in one cycle if he is rewarded successively by two different players.

It's important to understand that all the red Joystick reward buttons do exactly the same thing -- just as if they were physically wired together. All critters respond to a reward in exactly the same way -- no matter where it comes from. Thus, it doesn't matter who has which Joystick Controller as long as the defenders on each team use controllers one and two.

## METAMORPHOSIS

When you have mastered the basic form of the game, you can add some more excitement by introducing METAMORPHOSIS. Metamorphosis is the technical name for the process by which tadpoles turn into frogs and caterpillars turn into butterflies. It literally means change-form from the Greek (META=change, MORPHO=form). In FROGMASTER, tadpoles metamorphose into frogs, frogs lay eggs, and eggs hatch to make new tadpoles. The invention of birth required the invention of death, or else the number of critters would increase to fill the whole screen. Thus, when METAMORPHOSIS is on, frogs die of old age and eat players on the opposing team. The line backs and goalies no longer just spit out critters they catch -- now they swallow them whole.

The current state of the game (METAMORPHOSIS on or off) may be found by pressing the "M" key once. If you press the key a second time you will change the state to the opposite setting.

When METAMORPHOSIS is on, the scoring is slightly different. Tadpoles always score three points. Frogs score six points plus a bonus point for "conversion" if they score between the goalposts. You still need 50 points to win.

FROGMASTER critters breed asexually. Only one frog is required to lay an egg. In real life, all higher animals breed sexually and both a male and a female are required to produce offspring. This is so that the genetic traits from the two parents can be recombined. In FROGMASTER, the learned habits of the parent are passed on to each egg. This form of inheritance, known as Lamarckism, after the French Biologist Lamarck, does not occur in the real world. Whereas, FROGMASTER presents a reasonable simulation of operant conditioning, it presents an inaccurate model of natural selection.

What this means in actual play, is that once you have a well-trained frog, you can breed a clone of similarly trained critters to storm your opponent's lines.

The breeding process, itself, is subject to training. If we reward an egg for hatching, its descendants will hatch faster. If we reward a tadpole for metamorphosing, its descendants will metamorphose faster. If we reward a frog for becoming pregnant (pregnant frogs bounce up and down), that frog will become pregnant more often. With patience, we can breed a population that is either all frogs, all eggs, or all tadpoles. Note that only transitions are subject to training. The reward must be made immediately after the transition or it has no effect.



## GAME TIPS

**ATTACK** - There is no perfect defense in FROGMASTER. If you do not train your tadpoles to attack and score, you must eventually lose.

**TRAIN YOUR CRITTERS TO WEAVE** - The goalees are very good at stopping a critter coming in straight. Train your critters to weave. In Soccer your best chance to score is to go for the corners of the goal. In FROGMASTER you must shoot an angle to foil the goalee.

**SPEED UP GOOD PLAYERS** - Once you have a player going in the right direction, speed him up. Reward double jumps and long jumps (frogs only). the faster they come, the more often they score and the harder they are to intercept.

**UNTRAIN YOUR OPPONENT'S PLAYERS** - Reward your opponent's critters when they move your way or bounce off a wall. Encourage them to make straight single jumps.

**DRIVE YOUR OPPONENT INTO YOUR GOALEE** - Always be ready to give your opponent a push into the deadly embrace of your goalee or a line back. Give your own frogs a push if the extra hop will land them on one of your opponents critters.

**DEVELOP PERIPHERAL VISION** - Try to watch all the critters on the screen simultaneously. The more you practice, the better vision you can develop.

**Remember** - when it gets too easy, you can set the speed to maximum and add more critters.

## NOTES ON LEARNING THEORY ["D" KEY]

Each FROGMMASTER critter has a primitive brain consisting of twelve identical nerve cells (or neurons). Each neuron is arbitrarily wired to one of the twelve variables that control how the critter moves and changes form. Each neuron is capable of the very simplest response to a reward.

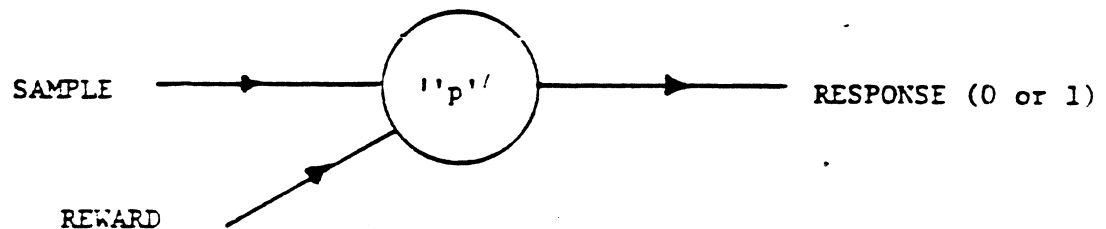


Diagram of a Nerve cell

When some specific behavior is desired (e.g., move left or move right), the neuron is sampled and produces a binary response (0 or 1) with a probability "p". If the response is immediately followed by a reward, the probability "p" increases if the neuron had just responded with a 1 and decreases if the neuron had just responded with a 0. This is called positive reinforcement. If the neuron is sampled and no reward follows, "p" changes by a much smaller amount in the opposite direction. This is known as forgetting or extinction.

This simple type of learning behavior is known as operant or instrumental conditioning. It occurs in real creatures throughout the animal kingdom up to and including man. Human brains are far more complex. The human brain contains in excess of 100 trillion cells -- each one of which is far more elaborate than those found in "Rana Electronica" (Rana = Frog, Electronica = Electronic). Yet the underlying mechanism is universal. Traditionally operant conditioning has been studied in rats and pigeons using a Skinner box. It is the method used to train performing seals and circus animals. Those clever tricks performed by animals on TV and in the movies are produced by operant conditioning. When the animal does the right thing, a clicker is sounded to indicate that it has earned a fish or seed or whatever morsel of food is appropriate. Training is accomplished in stages. The trainer becomes gradually more specific about the behavior he rewards. This approach should be used with FROGMMASTER critters.

To observe the learning process, we can place a probe into the head of any given critter on the screen and watch just what goes on as we modify its behavior. This action is done by pressing the "D" key, which turns on DISPLAY. When we press the key, one of the

critters on the screen will light up to show us which one we are observing. Pressing one of the number keys changes the critter that is being probed. By trial and error we can find the critter that we want to follow. If no critter lights up, we selected a critter that is not currently active and should try again.

When we go into DISPLAY, the bottom panel changes to the following form:

47	57	51	80	40	55
"x"		"y"		wv	db

Six neurons control the basic movements. The pairs marked "x" and "y" control the basic direction of movement. "x" represents left and right movement and "y" represents up and down movement. The left number in each pair shows the probability of moving at all in that direction, and the second number shows the direction (left/right or up/down) to move if a movement occurs. In the example, we see that the selected critter has a 51 per cent chance of moving in the y-direction and that if it moves it has an 80 per cent chance of moving up rather than down.

In competitive play, cell #2, which controls left versus right, is the most important cell to train. Cells #5 and #6, which control weaving and double jumping, are also important to train. Double jumping gets the critter to the goal faster and zig-zagging is important for evading the opponents goalee.

When WALLS are in use, two more neurons come into play. One controls whether tadpoles drill through the walls and the other controls whether frogs jump over the walls. The relevant probability of both conditions is displayed in the top right of the panel and indicated by a section of wall. That probability changes only when the critter jumps against a wall.

METAMORPHOSIS brings the final four neurons into play. One is used to permit frogs to make extra long jumps (two squares left or right in a single hop). The probability for this is shown at the bottom left under the "x". The other three control the transitions between different stages of the life cycle, which are tadpole to frog to egg to tadpole. The probabilities are displayed at the bottom of the panel.

As you can discover by experimentation, rewarding a neuron causes an immediate change in the displayed probabilities, either up or down, of perhaps 20 per cent. The higher the value of "p" the smaller the increase. The change is of such magnitude that random reinforcement produces an expected change of zero.

If no reward is given, the probabilities move by a small amount towards 50 percent. Some of the probabilities may remain unchanged. A cell's state is changed only when the behavior it produces is manifest (exhibited). For example, if there is no movement in the x-direction (cell #1 signals 0), then the effect on cell #2 (controlling left/right) is hidden. Cell #2 is, therefore, not manifest and its value of "p" isn't affected by the giving or withholding of reward in that cycle.

Reinforcement affects all cells that are manifest in a like manner. If you focus on how the critter moves in the x-direction and ignore how it moves in the y-direction, cell #3 and #4 will still be reinforced, albeit at random. Normally, their probabilities will drift up and down. On the average they should stay constant, but in any given experiment it is unlikely that they end up just where they started. On the contrary, it may happen, by chance, that a series of "random" reinforcements all add up to produce a significant change in "p". Just by chance we should expect such accidental runs to occur every so often. This effect may be observed in training animals and is known as "superstition".

#### AN EXPERIMENTER'S ENVIRONMENT

FROGMASTER has many frills to make a more exciting game. For example, a reward causes an extra jump, and critters must always move. By pressing the "G" key and turning GAME to off, we may suppress these extra frills. If you restart the game with GAME off, the line backs, goalees, and goal line will not appear. Thus you may obtain an empty tank in which training may be studied without distractions.

#### REFERENCES

Those interested in understanding operant conditioning in more depth may find more information in any major psychology text. The following books are recommended:

1. Introduction to Psychology by Hilgard, Atkinson, and Atkinson
2. Introduction to Modern Behaviorism by Howard Rachlin

## QUICK GAME REFERENCE

Variations on the basic game may be obtained using the following keys:

OPTION	Displays and selects the speed.
SELECT	Displays the game mode (e.g., PLAYER vs PLAYER) and lets you select other game modes.
START	Restarts the game. Scores are reset and all training is lost.
"P"	Causes the game to pause.
RETURN	Restarts play after a pause.
"0"-"9"	These keys normally reset the number of players per team. The effect is latent and you may have to also press START. The number keys have a different meaning when DISPLAY is on.
"W"	Turns WALLS on and off.
"D"	Turns DISPLAY on and off (see Notes on Learning Theory).
"M"	Displays METAMORPHOSIS and lets you turn it on and off. The effect is immediate. When METAMORPHOSIS is on, tadpoles turn into frogs and frogs lay eggs, and so on (see "Metamorphosis").
"G"	Lets you turn the game features off and on (see "An Experimenter's Environment").

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We're interested in your experiences with APX programs and documentation, both favorable and unfavorable. Many of our authors are eager to improve their programs if they know what you want. And, of course, we want to know about any bugs that slipped by us, so that the author can fix them. We also want to know whether our

instructions are meeting your needs. You are our best source for suggesting improvements! Please help us by taking a moment to fill in this review sheet. Fold the sheet in thirds and seal it so that the address on the bottom of the back becomes the envelope front. Thank you for helping us!

1. Name and APX number of program.

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2. If you have problems using the program, please describe them here.

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3. What do you especially like about this program?

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4. What do you think the program's weaknesses are?

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5. How can the catalog description be more accurate or comprehensive?

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6. On a scale of 1 to 10, 1 being "poor" and 10 being "excellent", please rate the following aspects of this program:

- \_\_\_\_\_ Easy to use
- \_\_\_\_\_ User-oriented (e.g., menus, prompts, clear language)
- \_\_\_\_\_ Enjoyable
- \_\_\_\_\_ Self-instructive
- \_\_\_\_\_ Useful (non-game programs)
- \_\_\_\_\_ Imaginative graphics and sound



7. Describe any technical errors you found in the user instructions (please give page numbers).

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8. What did you especially like about the user instructions?

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9. What revisions or additions would improve these instructions?

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10. On a scale of 1 to 10, 1 representing "poor" and 10 representing "excellent", how would you rate the user instructions and why?

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11. Other comments about the program or user instructions:

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From

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P.O. Box 3705  
Santa Clara, CA 95055

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